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# THE MOLDING MACHINE.

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## MOLDING OPERATIONS.

Broadly speaking, it is understood, that molding means making a depression, an impression or a cavity, in sand or in a similar yielding substance. This cavity is filled subsequently with a liquid mass, that sets, hardens, congeals or solidifies. The purpose of this process is to produce a casting of an object of desired outlines.

The simplest manner of making a mold is by pressing an object of any description into a mass of plastic clay. Should we perform the same operation in a body of molding sand on the floor of the foundry we would produce what is commonly known as an open sand mold. Numerous articles are thus molded and subsequently cast in a perfectly satisfactory manner; whenever it is not important to have the face of the casting smooth or clean. This method is most extensively applied in producing our commercial pig iron. Floor plates, flask clamps, weights, and many other products of our iron foundries, which are made in the same manner, are too well known to require further comment.

Yet even this simple manipulation requires that the sand used be of the proper quality and temper, that the face of the mold be made level, and that the sand be sufficiently compacted. We have here the fundamental principle of molding, which follows us throughout the whole art of founding.

As we may not return to this subject again, it may be well to state that castings are also produced in permanent molds. For iron we have examples in chilled pigs, rolls, car wheels, plow points, etc., and in general, wherever a hard surface is desirable. It is common practice to cast white metal, pewter, or Britannia metal, into iron or brass molds. Glass is cast in a similar man-

ner; plaster Paris is cast in wood, metal or plaster Paris. Small articles of gold and silver are usually molded by pressing the patterns into a piece of Cuttlefish bone (*sepia officinalis*). Plumbago is preferably molded in plaster Paris or wood; and nearly all other plastic materials are cast, molded or compressed into metal molds.

It is, undoubtedly, a highly interesting study to follow the various branches of molding and casting into their details. For instance to observe how intricate white metal objects are made by chilling a thin layer of the fluid material in the mold, then pouring out the liquid interior and thus producing hollow vessels of the most difficult shapes. Or, to see how hollow rubber goods are made without any opening at all in the object, by enclosing a drop of water within a lump of the plastic mass, then causing the water to expand, thereby enlarging the cavity and forcing the material into the finest engravings of the surrounding mold. But all this would lead us far astray from our present subject, and as far as may be, we shall confine ourselves in the following pages strictly to the process of sand molding.

It is well known, that it requires long experience and exceptional skill to produce the large variety of castings in iron, steel, brass, bronze or aluminum in sand molds, and it is understood that even these branches of the founding business are divided into numerous sub-branches, which are in the hands of specialists. No foundryman would expect a molder to be equally good on hollow ware, stove castings, light or heavy machinery castings and ornamental work. It requires a most skillful mechanic to master any one of these branches successfully. Let us but look over the long list of patterns and over the large variety of shapes, which come under the heading of each class, and we will no longer doubt that the constant changes to which the molder has to adapt himself require at least, good judgment on his part.

## ECONOMY IN PRODUCTION.

On the other hand, we must admit, that this is not true in all cases. All castings are not intricate, some shapes are exceedingly simple, in a great many instances the same pattern has

a long continuous run, then again many foundries produce articles which are frequently duplicated in considerable quantities; while there are others working on specialties, which are making only one kind or one class of castings year in and year out. These are but a few of many instances in which the same operations are constantly repeated, where the same manipulations are gone through over and over again, in the end becoming not only monotonous, but often distasteful to the skilled mechanic. In fact, his services are generally dispensed with in cases of this kind, his skill can be and is employed elsewhere to better advantage and to the better satisfaction of both parties. Such work is, therefore, turned over into the hands of selected foundry laborers.

It is the natural tendency of all foundry owners, superintendents and wide-awake foremen, to increase the production of their foundries with the least possible expenditure; and therefore, less experienced men, will gradually be entrusted with work which becomes more and more difficult to perform. Mechanical means and contrivances are frequently resorted to, to encourage green hands to expedite matters, and to insure success. All such labor saving devices are especially designed for the purpose of insuring a larger output, and to obtain more uniform, better, and cheaper castings, and in some degrees to take a part of the responsibility from the molder, and shift it upon the shoulders of the patient pattern maker. But, while such mechanical means are almost a necessity in the hands of less experienced men, they are none the less a great convenience and material help to the expert molder.

## GATES, CARDS AND PLATES.

To commence with the simplest of all labor saving devices for molding we must take up the loose gate or runner. This is placed on the mold board, next to the pattern and rammed up with it. Its advantage is evident in saving the hand work necessary for cutting the gate in the sand. In some instances these gates are directly connected to the pattern, forming one piece with it, thus saving the separate lifting of it out of the sand. Two or more patterns are frequently secured together to form

a gate; sometimes, especially for small castings, a dozen or more patterns are thus fastened together. Many molders prefer carded patterns, i. e. patterns fastened to a plate, to the usual gated ones. They have undoubtedly an advantage over the latter; they are stronger and they can stand more abuse.

It is sometimes more advantageous to use two independent plates for one set of patterns. If this is the case, one of them will be used for the drag side and the other for the cope side of the patterns. Should these two plates be held or secured together, with their backs adjoining they would be practically the same as the above mentioned cards

Match plates should be used with gated or carded patterns, to insure satisfactory working. They are rarely necessary when the patterns are placed on one side of the plate only. Using the face of a straight mold board as a bed for the plate to insure molds true to pattern will be found sufficient in most instances. By working each half by different men, double the quantity of castings can be produced in the same time, with patterns arranged in this manner, than when gated or carded. But it requires a set of carefully prepared flasks, which are especially fitted to the plates, to enable their use and successful application.

A pair of plates can be produced without much difficulty, by first drilling the full patterns at right angles to their parting faces for the necessary dowel pins or screws, then placing the two plates back to back together, inserting accurately fitting flask pins into holes provided for them therein, and suitable arranging and clamping one half of the patterns on their upper face. The holes drilled previously into the patterns are then used as jigs or guides for a drill to drill corresponding holes through both plates, and the lower halves of the patterns will match with the upper ones if secured to their respective positions.

The shape of the patterns often permits them to be molded with either side in the cope or in the drag. When this is the case, they can be advantageously secured to one side of the plate only, and the same plate, or rather the same side of the plate, is then used to produce both cope and drag.

Patterns prepared in this manner belong to a group possessing radically different characteristics from those of the foregoing. The nature of this arrangement involves some intricacy,

and to insure good castings the application of the patterns to the plates demands the utmost accuracy and greatest care at the hands of a skillful mechanic. A simple illustration will best serve to explain this subject.

Let us assume we have the pattern of a pinion with a flange on one of its sides. Ordinarily, we would leave the flange loose, place the toothed portion of the pattern on a mold board, ram it up in the drag, then turn over the drag with pattern, put flange in place, ram up the cope, lift off cope, turn it over, withdraw both parts of the patterns, and finally close the flask. When plated patterns are used we make two pinions as described in one flask, by securing the toothed portion and the flanged portion separately, but exactly in alignment with each other and at equal distance from the flask pin holes on the same face of the plate, as illustrated in Fig. 1.

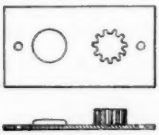

FIG. 1.

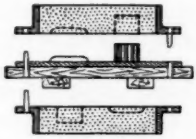

FIG. 2.

Thus prepared, the plate is placed on a mold board, a portion of the flask placed over it and rammed up with molding sand, and naturally we will get an impression of each of the patterns in the same part of the flask. The same process is then repeated with the second half of the flask and the same impressions are obtained in this one. Now, in placing these two portions of the flask together, it is only necessary to observe that the cope is turned in such a manner that its flanged portion will cover the toothed portion of the drag and vice versa. To avoid possible mistakes of this kind, each portion of a flask has only one pin which fits in a corresponding hole of its mate. The mold board is provided, likewise, with one pin and one pin bushing and carefully fitted to plate and flasks. Fig. 2 illustrates the relative positions of the cope and the drag, the plate with pattern

on the mold board is shown directly under the cope, indicating their relative positions directly after lifting off.

The advantage of this method of molding over the ordinary practice is apparent. It insures double the output with the same number of patterns and the same expenditure for labor. Good patterns with plenty of draft are easily withdrawn from the mold by carefully raising the plate, more or less rapping is necessary if patterns have little or no draft, or if their shapes are complicated. The rapping of the plate itself must be avoided; it is of little or no use if it fits closely to the flask pins as it should and in all cases it will have a tendency to damage not only the plate, but also patterns and flasks. This suggests the use of a double plate, one of them a stripping plate, which lies nearest to the face of the flask, and the second one a draw plate to which the patterns are secured. If held together and guided by independent pins which can be located outside the frame of the flask and move in bushings which should be closed above, we have a serviceable, inexpensive substitute for the molding machine. In fact, as a hand operated device, it is undoubtedly a very close approach to the more elaborate and more expensive molding machine.

While in the foregoing only straight plates have been described, it should be noted that these are not always suitable. Patterns cannot always be parted in straight lines, or, correctly speaking, in planes. Parting lines may consist either of broken straight lines, or of curves, or they may be composed of a combination of both. It is obvious, that the surface of the plates should correspond with the parting lines of such patterns, if they are to be plated. Sometimes there are good reasons to make the underside of the plate follow the shape of its upper surface, especially when the deviations from a plane amount to considerable depths, while in other instances when shallow—it may be preferable to make it in a straight plane. Plates with irregular undersurface must be used in connection with suitable match plates or match boards.

Other conditions may recommend the placing of one portion of the pattern above and another portion below the plate, especially when castings of hollow cross sections are to be produced. Plates arranged in this manner are practically pattern

and match in one piece. These have the advantage that straight plates can be used in place of irregular shapes. Irregular shaped plates are always expensive. For this reason alone, if for no other, they should be avoided, if possible.

Matches, when used in connection with plated patterns may be temporary or permanent. Temporary matches are made of molding sand in a flask belonging to the set fitting the plate. Permanent matches are made of oil sand, plaster of Paris or wood. They are always preferable for a continuous run of work. Frequently, if made of wood, they take the shape of a match board or box with certain portions cut out of it to permit of a protrusion of such parts of the patterns which extend beyond the undersurface of the plate.

The plates referred to in the foregoing, embrace nearly all variations with fixed and stable patterns which are in general use in our foundries. But before disposing of this subject we must mention as a class, distinct from the above, plates with movable patterns and plates with movable portions of patterns, which may be well termed and classified as mechanical pattern plates.

Many patterns have projections which make their withdrawal from the sand impossible without extra operations. Such projecting portions are usually secured loosely to the pattern by dovetails or dowels, and arranged in such a manner that they will remain in the mold when the main body of the pattern is lifted out of it. They are then picked out separately, and great care must be exercised by the molder that his mold is not being destroyed while he accomplishes this operation. This is always a tedious and costly manipulation, and gives just cause to the fervent wishes and sincere recommendations of the molder (always expressed in the strongest possible language) that the designer of such patterns should be compelled to serve a just and legal time as apprentice in a foundry.

When such projections cannot be avoided, these obstacles to molding can be quite frequently overcome by withdrawing them within the patterns by suitable mechanical means, before the main body of the pattern itself has been removed from the mold. Single patterns can be equipped in this manner, but

especially when metallic and plated patterns are used, such an arrangement is oftentimes advisable, and its application in practice will give not only satisfaction, but it will prove to be of advantage to the manufacturer and a desirable convenience in the hands of the molder.

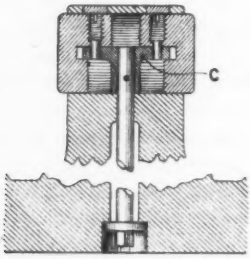


FIG. 3.

PLAN OF C.

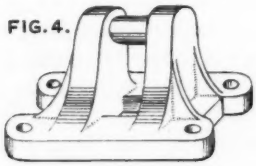

FIG. 4.

Figure 3 illustrates a simple devise for withdrawing in a single operation two projecting hubs sideways from the sand into the body of the pattern. The hubs are fitted into a corresponding recess of the pattern and each is provided with a screw or pin which reaches into a slot cut at right angles to its axis. In the slot lies a disc with cone-shaped openings which receive the ends of the pins or screws. A shaft is driven into the cam disc and reaches through the pattern to its face. A rotary motion can be imparted to the shaft by applying a socket wrench to the square at its lower end which in turn will act upon the pins of the hubs and move them inward or outward as the case may be. It is obvious that in this manner projections can be picked out of a mold at a depth and within a space, which would be quite impossible if attempted by hand.

As an example Figure 4 illustrates a casting with similar features, and Figure 5 gives the cross section of the pattern for

this casting secured to a plate, with an arrangement which will accomplish the desired object.

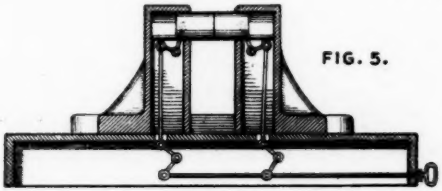

FIG. 5.

Plates, when properly equipped, are also admirably adapted to withdraw the entire pattern from the mold, before the flask is being lifted off. . . . This arrangement is especially valuable for molding wire sheaves, pulleys, discs, wheels and similar shapes which, when revolved around their center will permit of their turning out of the mold. Figure 6 shows a device of this kind equipped with patterns of webbed chain sheaves, part of them being in the position they would occupy in the flask while molding, and part of them being withdrawn.

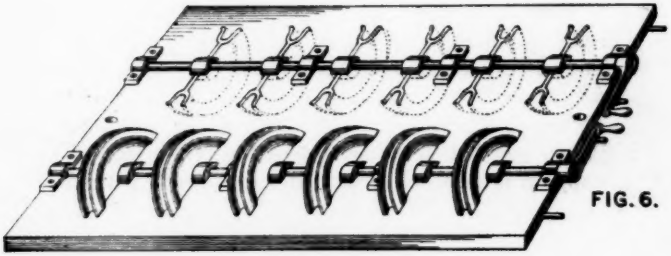

FIG. 6.

Such a device, though merely a plate with movable patterns, is practically a stripping plate molding machine in the fullest sense of the word. In fact there are few of the many elaborate design of molding machines more perfect, more affective and more serviceable than this. Its application, however, is

limited; it is little known and rarely used. It is costly to produce, as it requires exceedingly careful workmanship, and an equipment of flasks which must be kept in excellent condition to insure castings.

All plates, as described, are used with good advantage independently, but they can, without any alterations, be used equally well in connection with molding machines, and in most cases they are actually one of the principle parts of them.

In concluding this chapter there remains to be considered to what extent plate molding is to be recommended for adoption in our foundries, and to summarize the principle advantages which it presents over ordinary hand molding. The following deductions are made from the foregoing explanations:

1. Plated patterns give the best service when used continuously.
2. Castings which are to be produced in quantities are preferably molded with plated patterns.
3. Standard patterns are preferably plated for economic production in the foundry.
6. Plated patterns should be made of metal to give good service.
4. When plated patterns are used, good flasks only will insure good castings.
5. Accurate workmanship is one of the main requisites in plated patterns.
8. The use of wooden patterns on plates is not excluded.
9. All patterns when placed on plates should be provided with plenty of draft.
7. Plated metal patterns are preferably made hollow.
10. Rapping is destructive to plates and plated patterns.